We claim:

1. A method for forming a product from cellulosic material and thermoactive material, comprising:

providing a mixture comprising a predetermined amount of cellulosic material and a predetermined amount of thermoplastic material;

forming a mat from the mixture

consolidating the mat;

pressing the mat to a predetermined final product thickness; and

surface modifying at least a portion of a surface of the mat or product made from the mat.

2. The method according to claim 1 further comprising embossing a face of the product.

3. The method according to claim 1 where the product includes a textured face.

4. The method according to claim 1 where a surface of the product is substantially smooth.

5. The method according to claim 1 where consolidating comprises applying heat and pressure to the mixture.

6. The method according to claim 1 where the cellulosic material comprises wood and the thermoactive material comprises waste thermoplastic.

7. The method according to claim 6 where the thermoplastic material is polyethylene.

8. The method of claim 1 where providing the mixture comprises forming a mixture having a predetermined amount of wood pieces and a predetermined amount of thermoplastic pieces.

9. The method of claim 8 where forming the mixture comprises sorting the wood pieces by size and flaking selected wood pieces into flakes having desired sizes.

10. The method of claim 8 where forming the mixture includes granulating the thermoplastic pieces into flakes having desired sizes.

11. The method of claim 10 where granulating the thermoplastic pieces includes granulating a portion of the flakes into fines having desired sizes.

12. The method of claim 8 where forming the mixture includes making a face layer mixture and making a core layer mixture.

13. The method of claim 12 where consolidating the mixture into a mat includes:

forming a first face layer of the face mixture;

forming a core layer of the core layer mixture on the first face layer; and forming a second face layer of the face layer mixture on the core layer.

14. The method of claim 12 where making the face layer mixture includes mixing the plastic fines and wood fines in a predetermined ratio.

15. The method of claim 12 where making the core layer mixture includes mixing the plastic flakes and the wood flakes in a predetermined ratio.

16. The method of claim 13 where forming the core layer includes depositing mixtures of wood flakes and plastic flakes according to mixture flake size in successive layers such that the core layer has larger flakes adjacent the first face layer and adjacent the second face layer, and smaller flakes between the larger flakes in a middle portion of the core layer.

17. The method of claim 1 and including depositing the mixture on a moving surface and aligning the wood flakes in a predetermined direction.

18. The method of claim 17 where at least depositing the mixture and consolidating the mixture occur in a continuous process.

19. The method of claim 17 where at least depositing the mixture, consolidating the mixture and pressing the mat occur in a continuous process.

20. The method of claim 1 where at least pressing is a batch process.

21. The method of claim 1 where at least forming is a batch process.

22. The method of claim 1 where at least consolidating is a batch process.

23. The method of claim 1 where consolidating includes applying pressure to major surfaces of the mat.

24. The method of claim 1 where consolidating includes applying

pressure to major surfaces of the mat as the mat is fed along a process direction.

25. The method of claim 1 where pressing includes applying pressure to major surfaces of the consolidated mat.

26. The method of claim 1 where pressing includes pressing the consolidated mat from opposite sides at a pressure of from about 100 psi to about 400 psi.

27. The method of claim 1 where pressing includes pressing the consolidated mat from opposite sides at a pressure of from about 200 psi to about 300 psi.

28. The method of claim 1 wherein pressing includes cooling side edges of the mat.

29. The method of claim 1 where pressing includes embossing a pattern on at least one of the major surfaces of the mat.

30. The method of claim 1 further comprising fusing a sheet comprising a plastic material to at least one major planar surface of the mat.

31. The method of claim 30 further comprising surface treating the plastic material.

32. The method of claim 1 further comprising coupling a plastic material to at least one major surface of the mat.

33. The method of claim 1 further comprising subjecting at least one major surface of the mat to e-beam treatment.

34. The method of claim 1 further comprising subjecting at least one major surface of the mat to corona discharge.

35. The method of claim 1 further comprising subjecting at least one major surface of the mat to flame treatment.

36. The method of claim 1 where surface modifying further comprises applying grafting chemicals to a surface treated product.

37. The method of claim 36 where applying grafting chemicals comprises spraying the grafting chemicals onto the surface treated product.

38. A method for forming a three-layer composite product from mixtures of wood and thermoplastic material, comprising:

forming face layers from a mixture of fine particles of wood and fine particles of plastic;

forming a core layer from a mixture of wood flakes and plastic flakes;

continuously forming a mat comprising a first face layer and a second face layer, an the core layer between the first face layer and the second face layer;

continuously consolidating the mat through application of heat and pressure to the mat;

pressing the consolidated mat to a desired final thickness of the product; and

surface treating at least one surface of the mat.

39. A method for forming a product having a first face layer and a core layer, comprising:

preforming a first face layer; and

depositing a core layer on an upper surface of the preformed first face layer.

40. The method according to claim 36 where the product further comprises a second face layer.

41. The method according to claim 40 where the method further comprises placing a preformed second face layer on an upper surface of the core material.

42. The method according to claim 41 where the second face layer is deposited on the core.

43. The method of claim 39 where depositing the core layer comprises depositing the core layer on a moving first face.

44. The method of claim 39 where depositing the core layer includes depositing a lower core layer of larger flakes, depositing a core middle layer of smaller flakes and depositing a core upper layer of larger flakes.

45. A method for forming a face layer for a composite product, comprising:

making a face layer mixture comprising predetermined amount of thermoplastic material and cellulosic material;

depositing the mixture on a forming surface; and

heating the mixture to a mixture activation temperature.

46. The method of claim 45 where heating comprises applying heat energy to the mixture to form a melted face layer.

47. The method of claim 45 where heating comprises IR heating.

48. The method of claim 46 further comprising cold rolling the melted face layer.

49. The method according to claim 48 and further comprising turning over the face layer.

50. The method according to claim 49 and further comprising heating the turned facer.

51. The method according to claim 50 comprising heating the face layer using IR.

52. The method according to claim 51 further comprising cold rolling the face layer.

53. The method of claim 42 where the forming surface includes a moving belt, and depositing the mixture includes depositing the mixture on the moving belt.

54. The method of claim 45 further comprising pressing the deposited mixture between two flat surfaces to form the face layer.

55. The method of claim 54 where pressing includes pressing the mixture between two converging moving belts.

56. The method of claim 55 where pressing occurs at major surfaces of the deposited mixture.

57. The method of claim 56 where heat is applied to one or both surfaces through at least one of the belts.

58. The method of claim 56 further comprising releasing the formed face layer.

59. A method for making a cellulosic-thermoactive composite, comprising:

providing a wood material;

flaking the wood material into flakes;

separating the flakes into large flakes and small flakes;

flaking the larger flakes into small flakes;

forming a mixture by combining wood flakes of like sizes with thermoactive flakes;

forming a composite product from the mixture.

60. The method according to claim 59 and further comprising:

providing a thermoplastic material;

flaking the thermoplastic material into plastic flakes separately from the wood material; and

combining wood flakes with plastic flakes to form the mixture.

61. A method for forming a multilayer product, comprising:

forming a first face layer comprising a mixture of cellulosic material and plastic material;

forming a second face layer separately from the first face layer;

forming a core separately from the first and second face layers;

placing the core on the first face layer;

placing the second face layer on a top surface of the core; and

consolidating the multilayer product by the application of heat and pressure.

62. A method for forming a composite product, comprising:

providing a mixture comprising thermoplastic material and cellulosic material;

forming a mat from the mixture; and

subjecting at least a portion of the mat to a first flow of hot, dry non-condensable gas.

63. The method according to claim 62 and further comprising subjecting the mat to a second flow of hot, dry non-condensable gas.

64. The method according to claim 63 where the first flow and the second flow are fluidly isolated one from another.

65. The method of claim 63 comprising subjecting the at least one portion of the mat to the first flow in a first direction through the mat and directing the second flow in a second direction through the mat.

66. The method of claim 65 where the first and second directions are opposite.

67. The method of claim 65 where the first and second directions are the same.

68. The method of claim 63 where the first and second flow are both downward through the mat.

69. The method of claim 63 where the first and second flow are both upward through the mat.

70. The method of claim 63 where the first flow is downward through the mat and the second flow is upward through the mat.

71. The method of claim 63 where the first flow is upward through the mat and the second flow is downward through the mat.

72. The method of claim 63 where the fluid flows are closed.

73. The method of claim 63 where the fluid flows are substantially closed.

74. The method of 73 and further including bleeding off a predetermined portion of the gas.

75. The method of claim 74 and further comprising mixing non-VOC containing gas with the hot, dry non-condensable gas.

76. The method of claim 75 where the non-VOC containing gas is air.

77. The method of claim 62 where subjecting at least a portion of the mat comprises circulating the gas through the mat by applying pressurized gas to one surface of the mat.

78. The method of claim 77 where pressure of the pressurized gas is from about 0.2 psi to about 1.2 psi.

79. The method of claim 78 where pressure of the pressurized gas is from about 0.2 psi to about 0.6 psi.

80. The method of claim 78 where pressure of the pressurized gas is from about 0.2 psi to about 0.4 psi.

81. The method of claim 62 further comprising applying pressure to opposite surfaces of the mat.

Sub A' 82. A cellulosic and thermoactive composite product, comprising:

a core; and
at least one face layer.

83. The product of claim 82 where cellulosic flakes in the core are graduated by length.

84. The product of claim 82 where the cellulosic flakes are aligned.

85. The product according to claim 82 where the cellulosic flakes are graduated and aligned.

86. The product of claim 82 where the thermoactive material is a thermoplastic.

87. The product of claim 86 where the thermoplastic material is polyethylene.

88. The product of claim 82 having a core wood-to-plastic ratio of from about 10:90 to about 90:10.

89. The product of claim 82 having a core wood-to-plastic ratio of from about 45:55 to about 55:45.

90. The product of claim 82 where the wood-to-plastic ratio is about 50:50.

91. The product of claim 82 where the face layer has a wood-to-plastic ratio of 0:100 to 90:10.

92. The product according to claim 82 where a wood-to-plastic ratio in the face layer is from about 30:70 to about 70:30.

Sub A2

93. A cellulosic and thermoactive composite, comprising a first surface and a second surface, the composite having cellulosic fines adjacent the first and second surfaces, longer flakes adjacent the cellulosic fines and graduating to shorter flakes at a center portion of the product.

Sub D2

94. The product according to claim 93 where a cellulosic fines layer adjacent the first and second surfaces has a thickness of from about 1/48 inch to about ¾ inch.

95. The product according to claim 93 where a cellulosic fines layer adjacent the first and second surfaces has a thickness of from about 1/36 inch to about ¼ inch.

Sub A3

96. A composite board product, comprising:

a core formed from a mixture of a cellulosic material and a thermoplastic material; and

at least one surface-treated face layer attached to at least one major surface of the core, the at least one face layer being formed from a mixture of a cellulosic material and a thermoplastic material.

97. The product of claim 96 further comprising at least one thermoplastic layer fused to the at least one face layer on a side opposite the core.

98. The product of claim 96 where the at least one face layer is flame treated.

99. The product of claim 98 and further comprising grafting chemicals coupled to the at least one face layer.

100. The product of claim 96 where the at least one face layer is e-beam treated.

101. The product of claim 96 e-beamed through its cross section.

102. The product of claim 100 and further comprising grafting chemicals coupled to the at least one face layer.

Sub A4

103. A composite product, comprising:

a first portion comprising a first core formed from a mixture comprising a cellulosic material and a thermoplastic material, and at least one face layer attached to at least one major planar surface of the first core, the at least one face layer being formed from a mixture of a cellulosic material and a thermoplastic material; and

a second portion bonded to the first portion, the second portion comprising a second core formed from a mixture comprising a cellulosic material and a thermoplastic material, and at least one face layer attached to at least one major planar surface of the second core, the at least one face layer being formed from a mixture of a cellulosic material and a thermoplastic material.

104. The product according to claim 103 where the first portion includes two face layers attached to major planar surfaces of the first core.

105. The product according to claim 103 where the second portion includes two face layers attached to major planar surfaces of the second core.

106. The product according to claim 103 where both the first and second portions include two face layers attached to major planer surfaces of the first and second cores.

107. The product according to claim 103 where at least one of the face layers is surface treated.

108. The product according to claim 103 where both of the face layers are surface treated.

109. The product according to claim 107 where the at least one face layer is flame treated.

110. The product according to claim 107 where the at least one face layer is e-beam treated.

111. The product according to claim 103 e-beamed through its cross section.

112. A composite product, comprising:

a core formed from a mixture of a cellulosic material and a thermoplastic material; and

at least one surface treated face layer attached to at least one major planar surface of the core, the at least one face layer being formed from a mixture of a cellulosic material and a thermoplastic material, the surface layer having grafting chemicals coupled thereto.

113. The composite product of claim 112 having at least one painted surface.

114. The composite product of claim 112 having a laminate coupled to the surface treated face layer.

115. The composite product of claim 112 having at least one overlay.

116. The composite product of claim 112 having at least one functional overlay.

117. The product of claim 112 where a laminate is attached to the face layer before it is surface treated.

118. A multi-layer composite product, comprising:

a preformed consolidated top layer comprising cellulose and a thermoplastic material;

a preformed consolidated bottom layer comprising cellulose and a thermoplastic material; and

a non-consolidated core section between the top and bottom layer.

119. The product according to claim 118 where the thermoplastic material is polyethylene.

120. An apparatus for forming a composite product formed of layers of wood and thermoplastic mixtures, the product having at least one face layer and a core layer, comprising:

a face layer forming station that forms the at least one face layer;

a mat consolidation station that forms a consolidated mat from the at least one face layer and the core layer;

a mat pressing station that presses the consolidated mat;

a fusing station that presses the consolidated mat; and

a surface treating station that surface modifies at least one surface of the mat.

121. A face layer forming apparatus for forming a face layer of a composite board product formed of layers of wood and thermoplastic mixtures, comprising heated upper and lower surfaces spaced apart by a desired thickness of the formed face layer.

122. The apparatus of claim 121 where the upper surface includes an upper moving belt and the lower surface includes a lower moving belt, and wherein the upper moving belt and the lower moving belt contact respective upper and lower face layer surfaces to move the face layer through the apparatus.

123. The apparatus of claim 122 where the upper surface and the lower surface are stick resistant.

124. The apparatus of claim 122 where the upper moving belt and the lower moving belt each includes a layer of polytetrafluoroethylene.

125. The apparatus of claim 122 where the upper moving belt and the lower moving belt are spaced apart by a desired face material starting thickness at a feed end and by a desired formed face layer thickness at a delivery end opposite the feed end.

126. The apparatus of claim 122 where the upper moving belt and the lower moving belt are circulated at substantially the same speed.

127. A consolidation apparatus for consolidating a mat formed of layers of thermoplastic and wood mixtures, the apparatus comprising:

a support surface upon which the mat is formed; and

a heated body portion adjacent at least a portion of the support surface in which the mat is raised to an activation temperature of the thermoplastic material.

128. The consolidation apparatus of claim 127, wherein the support surface is a moving belt.

129. The consolidation apparatus of claim 128, wherein the moving belt is perforated.

130. The consolidation apparatus of claim 127, wherein the support surface is a lower moving belt and the apparatus includes an upper moving belt positioned to contact an upper surface of the mat, the lower and upper moving belts being driven to move in a process direction at substantially the same rate.

131. The consolidation apparatus of claim 130, further comprising lower rollers and upper rollers that circulate the lower and upper moving belts, respectively, and wherein an upper roller positioned adjacent an exit end of the heated body portion is adapted to lessen a pulling force exerted by the upper moving belt on an upper surface of the mat as the mat exits the heated body portion.

132. The consolidation apparatus of claim 131, wherein a lower roller positioned adjacent an exit end of the heated body portion is adapted to lessen a pulling force exerted by the lower moving belt on a lower surface of the mat as the mat exits the heated body portion.

133. The consolidation apparatus of claim 130, wherein the lower moving belt and the upper moving belt are perforated.

134. The consolidation apparatus of claim 130, wherein a portion of the lower moving belt extending through the heated body

portion is substantially horizontal, and wherein a portion of the upper moving belt extending through the heated body portion is angled downwardly relative to horizontal in the process direction.

135. The consolidation apparatus of claim 127, further comprising at least a pair of nip rollers positioned adjacent the heated body portion, the nip rollers receiving the heated mat and pressing opposite surfaces of the mat to a desired final caliper.

136. The consolidation apparatus of claim 135, wherein the nip rollers are temperature controlled.

137. The consolidation apparatus of claim 136, wherein the nip rollers are maintained at a temperature less than a temperature of the heated mat.

138. The consolidation apparatus of claim 127 where the heated body portion includes a gas distribution system that directs heated gas onto the mat.

139. The consolidation apparatus of claim 127, wherein the heated body portion includes a gas distribution system with at least a first zone and a second zone, the first zone and the second zone being fluidly isolated from each other, and wherein the mat is heated with gas in the first zone and in the second zone.

140. The consolidation apparatus of claim 139, wherein the support surface is a belt movable in a process direction, and wherein the first and second zones are arranged adjacent each other in the process direction within the heated body portion.

141. The consolidation apparatus of claim 139, wherein each of the first zone and the second zone includes a fan to direct a gas flow onto one surface of and through the mat.

142. The consolidation apparatus of claim 141, wherein the first zone is configured to direct the gas flow in the first zone onto a first surface of the mat, and the second zone is configured to direct the gas flow in the second zone onto a second surface of the mat, the second surface being opposite the first surface.

143. The consolidation apparatus of claim 139, wherein the gas in each of the first zone and the second zone is recycled.

144. The consolidation apparatus of claim 139, wherein each of the first and second zones includes an exhaust outlet and a fresh air intake.

145. The consolidation apparatus of claim 144, wherein a portion of the gas in each of the first zone and the second zone is exhausted through the respective air intake, and a portion of make-up air is added the respective air intake.

146. An apparatus for sorting cellulosic and thermoplastic flakes of different sizes used in forming a composite product, comprising:

a frame positioned above a receiving surface;

a plurality of axles coupled to the frame, each of the axles rotatably supporting a plurality of spaced apart sprockets, the axles being driven to rotate the sprockets in a movement direction; and

a plurality of zones arranged in the movement direction, each zone being defined by a spacing between adjacent axles within the respective zone, the spacings defining openings through which correspondingly sized flakes can pass,

wherein flakes dispensed onto the frame in a first zone are moved in the movement direction through successive zones by rotation of the sprockets with flakes passing through the openings and being deposited on the receiving surfaces in accordance with the sizes of the flakes.

147. The apparatus of claim 146, wherein the openings in the respective zones increase in size from the first zone through each successive zone in the movement direction.

148. The apparatus of claim 146, wherein the receiving surface is a moving surface moving in a process direction.

149. The apparatus of claim 148, wherein the process direction of the moving surface is opposite the movement direction of the flakes.

150. The apparatus of claim 146, further comprising a dispenser positioned adjacent one end of the frame to dispense the flakes onto the first zone.

151. The apparatus of claim 146, wherein the frame is inclined relative to horizontal.

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152. An apparatus for sorting cellulosic and thermoplastic flakes of different sizes used in forming a composite product, comprising:

a first sorting device, having a first frame positioned above a receiving surface, a plurality of axles coupled to the frame, each of the axles rotatably supporting a plurality of spaced apart sprockets, the axles being driven to rotate the sprockets in a first movement direction, and a plurality of zones arranged in the first movement direction, each zone being defined by a spacing between adjacent axles within the respective zone, the spacings defining openings through which correspondingly sized flakes can pass;

a second sorting device positioned adjacent the first forming device, the second sorting device having a second frame positioned above the receiving surface, a plurality of axles coupled to the frame, each of the axles rotatably supporting a plurality of spaced apart sprockets, the axles being driven to rotate the sprockets in a second movement direction, and a plurality of zones arranged in the second movement direction, each zone being defined by a spacing between adjacent axles within the respective zone, the spacings defining openings through which correspondingly sized flakes can pass,

wherein flakes dispensed onto the first and second frames in respective first zones are moved in respective first and second movement directions through successive zones by rotation of the sprockets with flakes passing through the openings and being deposited on the receiving surface in accordance with the sizes of the flakes.